STUDY GUIDE FOR WOOD-DESTROYING ORGANISM PEST CONTROL

The educational material in this study guide is practical information to prepare you to meet the written test requirements. It doesn't include all the things you need to know about this pest-control subject or your pest-control profession. It will, however, help you prepare for your examinations.

Contributors include the Utah Department of Agriculture and Food and Utah State University Extension Service. This study guide is based on a similar one published by the Colorado Department of Agriculture. Materials for that guide were prepared by Colorado State University Extension Service. Other contributors include: University Extension Service personnel of California, Kansas, New York, Oregon, Pacific Northwest, Pennsylvania, and Wyoming. The U.S. Department of Agriculture -- Forest Service, the U.S. Environmental Protection Agency (Region VIII Office), and the Department of Interior -- Bureau of Reclamation, and Metro Pest Management.

Other topics that may be covered in your tests include First Aid, Personal Protective Equipment (PPE), Protecting the Environment, Pesticide Movement, Groundwater, Endangered Species, Application Methods and Equipment, Equipment Calibration, Insecticide Use, Application, Area Measurements, and Weights and Measures. Information on these topics can be found in the following books:

1. *Applying Pesticides Correctly: A Guide for Private and Commercial Applicators.* U.S. EPA, USDA and Extension Service, revised 1991.

2. *Applying Pesticides Correctly: A Supplemental Guide for Private Applicators.* U.S. EPA, USDA and Extension Service, December 1993, Publication E-2474.

These books can be obtained from the Utah Department of Agriculture and Food or Utah State University Extension Service. Please contact your local Utah Department of Agriculture and Food field representative or Utah State University extension agent.

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INTRODUCTION

Termites have been around for more than 250 million years. They are social insects and live in colonies that are usually located in the ground or in wood. Termites feed on cellulose from wood and wood by-products such as paper. They are worldwide in distribution, with about 2,200 described species and with about 40 species occurring in the United States.

Termites are usually divided into three groups based on the location of the colony: subterranean, drywood, and damp-wood termites. The biology and habits of each group are different, so a detailed knowledge of each is necessary for effective control.

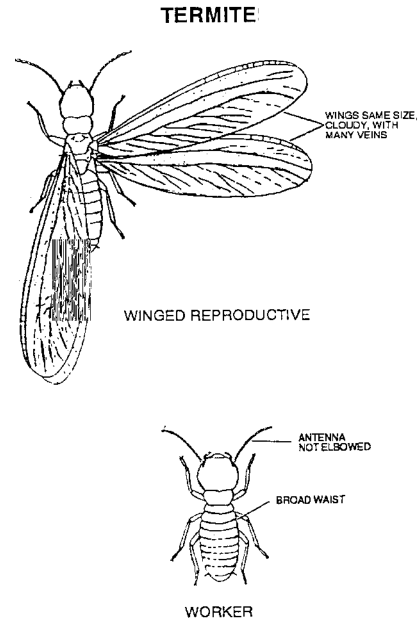
The most common of the subterranean termites are the eastern and western subterranean; for the dry-wood termites, the western drywood and the powderpost termites are the most important; and of the damp-wood termites, the Pacific damp-wood termites cause the most problems.

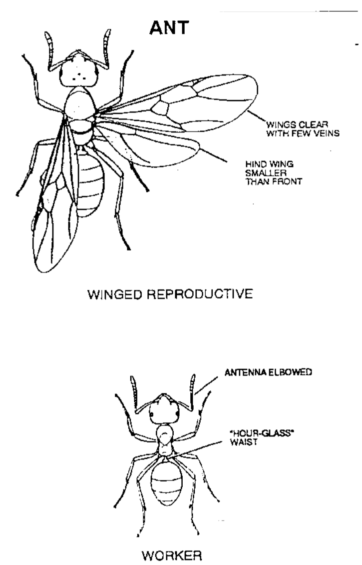
TERMITES

GENERAL BIOLOGICAL INFORMATION

Subterranean termites are the most serious insect pests of structural wood in Utah buildings. Although infestations are relatively fewer than in many regions of the United States, problems with termites can and do occur in the state. In particular, areas of the state where the eastern subterranean termite has become established have occasional problems that require treatment.

Cellulose-containing material is digested by the termite and turned into nutrient-rich food by the action of protozoans that are a permanent part of the digestive tract of all termites. (Termites don’t produce any sawdust as the other wood-boring insects do.) Badly damaged wood may have the interior sapwood completely riddled, although the exterior remains intact and seems sound. Termites also drag in mud and pile excrement in the tunnels.





Termites belong to the insect order Isoptera (equal wings), which has several characteristics. They have three body regions (head, thorax and abdomen). When wings are present, there are usually four wings, with both pairs of similar size and shape. The wings are almost clear to smoky black in color.When the termite isn’t flying, its wings are laid on its back and extend far beyond the tip of the abdomen. After mating flights, termites break off their wings along a suture at the base of the wing. The winged stages are most commonly observed as they emerge from nests and mate in late winter and spring.

Termites are sometimes called "white ants"; however they are very different in habit from true ants. Light colors of termites and the broad attachment of the thorax (midsection) and the abdomen (hind section) make worker and soldier stages of termites look different than ants. Also, antennae of ants are elbowed, while the antenna of termites resembles a string of small beads (moniliform).

Winged stages of both termites and ants are dark in color but can be easily separated by examining the wings. Wings are roughly equal in size with the termites, while hind wings of ants are much smaller than the front wings.

Subterranean termites are most destructive to wooden structures in direct contact with the ground. In Utah, termites will build "shelter tubes" on the extension of foundations to reach wood or use tunneling in crawl spaces and basements.

TERMITE-COLONY FORMATION

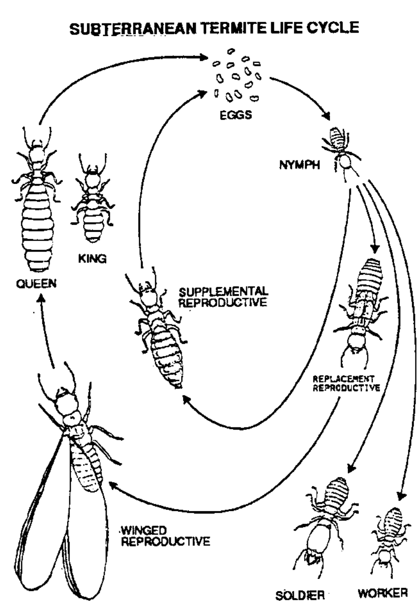
Termites have a simple metamorphosis: egg, nymph and adult. Termites have the most complex social organization found among any insects. The common traits of social insects are: (1) cooperative caring for the young, (2) a division of labor in which sterile individuals work for fertile individuals, and (3) an overlap of at least two generations and life stages so that during some of their life, the offspring can help the parents. A society can be developed only if its members are long-lived. This, in turn, depends on an adequate and continuous food supply. Termites have solved this problem by acquiring the ability to use wood as food.

Termite colonies occur underground. They contain different types (castes) of termites. Only a few of the eggs develop into individuals that can reproduce, the primary **reproductives** (queen, king) and secondary reproductives in more mature colonies. The bulk of the colony consists of sterile **workers** that maintain the colony, build and repair the nest, forage, and feed the colony. **Soldiers** are sterile females and have one function, to protect the colony. The soldiers have massive heads with greatly enlarged mandibles to use in defending the colony.

Termites depend on microscopic protozoa in their hind-guts to break down cellulose for food. Termites don’t possess these protozoa when they are born; they must get them by feeding from other individuals in the colony. They feed on a liquid intestinal content taken from the anus of an older termite. Every time a termite molts, the lining of the hind gut is shed along with the entire body skeleton, and the protozoa are lost. To get more protozoa, the termite must get additional feeding by other individuals.

The primary swarmers or alates (winged forms) are the members of the colony most likely to be seen by the homeowner. They are the potential kings and queens, and the homeowner often confuses the winged stages with winged ants.

The queen's life begins with mating at swarming time. Swarms occur in the early spring, or even in late winter inside heated homes. The reproductives are ready to break out of the colony when stimulated by a warm day after a spring rain. The rule of thumb is that termites generally will swarm within ten days following the first warm spring rain. Not all colonies will swarm every year, but subterranean termites generally hold to the above rule of thumb.



In the swarm, both males and females reproduce. They are more darkly colored than the pale, creamy-white-colored workers. The swarm is a dispersal flight, and as the termites fall to the ground after their short, fluttering flight, they break off their wings. A male and female will search out a crack or crevice in the soil or near wood. Subterranean termites may excavate their nest in wood found after digging into the ground, between a piece of wood and damp ground, or in a crevice in wood on damp ground. Almost all nesting occurs in the ground, although nesting directly in structures is possible if high-humidity conditions occur.

The pair then mates, and the first eggs are laid. Usually six to 12 eggs comprise the first batch of eggs. The queens, males and females live together for life. Once these worker-nymphs hatch, they begin to eat cellulose products and enlarge the colony area. With many nymphs, the queen will lay increasingly larger numbers of eggs. It takes two to three years for a newly established colony to begin to do serious damage to structural wood. During this time, the colony begins a faster rate of increase because secondary reproductives also begin to lay eggs to supplement the queen's supply.

Detection of termites during early colony development is much less likely because the obvious signs of swarming aren't evident in a young colony. The best clues for potential termite damage at this time are tubes built on the interior or exterior foundation walls between the soil and structural wood.

Colonies develop slowly, and several years may pass before all castes are present in a new colony. Often, three to five years pass after initial colony establishment before movement into structures occurs. Natural cellulose (brush, discarded timbers, cattle manure) is often used first by the colony, and structural infestations may not occur until these sources are spent. As colonies develop, tunneling becomes increasingly extensive and, in old colonies, penetrates many feet in depth. The complete colony consists of the primary pair of reproductives (king and queen), secondary reproductives, workers, and soldiers. The workers feed on wood or fungi. By regurgitation and excretion, they also provide food for the young and other castes.

Subterranean termites enter homes in many ways. Any wood in contact with the soil such as wood supports through concrete slabs or siding touching the soil is an excellent entry path. Cracks in concrete foundations and open voids in concrete-block foundations are also hidden routes of entry. Expansion cracks around buildings, at the soil/foundation interface, or where a stoop or porch joins with a foundation provide ideal points of entry. Scrap wood and sawdust buried during construction, along with the natural condensation characteristic of foundations, provide both food and moisture.

TERMITES AND THEIR ENVIRONMENT

In areas where winters are mild, termites are active throughout the year. They can occur in heated buildings in Utah.

To a limited extent, termites can regulate temperature conditions to suit themselves and the colony. Their burrows often are situated so that some run above ground, and some below. Therefore, during extremes of cold or hot weather, the termites will be found in burrows situated some distance below the ground, where temperature conditions are more favorable.

Termites prefer to live in complete darkness and actively avoid light; any openings that expose the colony are usually sealed rapidly by the workers. Termites are nearly blind and require an environment where temperature, moisture, and oxygen pressure are to some extent under their control. As a result, they often won't cross a barrier that's too dry or that's exposed to light. However, termites sometimes build shelter tubes of mud to cross to wood. These shelter tubes are most often observed along foundations underneath buildings.

The amount of moisture required for different species of termites is extremely variable. Subterranean termites, common in Utah, need a constant, ample supply of moisture. Part of this moisture is acquired from the water produced by their own metabolism and part from soil moisture around the tunnels or tubes.

Fungi, when present in the wood, serve as another source of moisture, being consumed directly. These fungi aid in the regulation of humidity in the passages.

The plugs of partially chewed food and feces placed by the termites in the passages also help in the regulation of moisture content.

Dry-wood termites can colonize dry, seasoned wood. This is possible since wood absorbs some moisture from the air and thus provides moisture for the termites. The subterranean termite colony usually gets its moisture from the soil and is greatly dependent on soil types. Moisture in clay soils is tightly bound to the particles and not readily available to the termite, whereas sandy soils allow the moisture to be available. Consequently, termites are more prevalent and more able to survive in sandy soils.

Termites can detect vibrations through their legs. They are unable to hear a noise near the nest but are immediately aroused when the nest is tapped. When alarmed, soldier termites rattle their hard heads against the walls to begin the vibrations which warn the entire colony. It's believed that termites, like ants, can communicate with one another through movements of their antennae.

SUBTERRANEAN TERMITES OF UTAH

The arid-land subterranean termite, *Reticulitermes tibialis*, is a native insect found throughout the lower elevations (below 8,500 feet) of Utah. In some areas, it feeds mainly on dried cattle manure and brush. Despite this termite's widespread distribution, damage to structures is relatively rare. Where injury does occur, it's often limited to specific regions or even small areas within the region. Subsoil conditions, local sources of humidity, and other factors are important in where infestations occur. Flights of arid-land subterranean termites are most often seen on one of the first warm days of late winter or early spring. Indoors, they have emerged as early as mid-February. Less common fall flights also occur.

Key to the winged stages of subterranean termites found in Utah.

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1. Winged stage yellow-brown to brown ....*Reticulitermes hageni*
1. Winged stage brownish-black to black ....see 2
2. Winged stage very black; upper leg (tibia) black to sooty.....*Reticulitermes tibialis*
2. Winged stage brownish-black to black; tibia pale yellow, almost colorless...............see 3
3. Wings almost colorless except in the fore area; wings less than 6 mm long......*Reticulitermes virginicus*
3. Wings faintly to clearly grayish or brownish; forewing usually distinctly darker than hindwing; wings usually more than 6 mm long ....*Reticulitermes flavipes*

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The **eastern subterranean termite**, *Reticulitermes flavipes*, is the most destructive species of termite in Utah. It's the common termite of the northeastern United States and has expanded its range into Utah. Although less common than the arid-land subterranean termite, it has often been more damaging. It appears to require somewhat higher humidity than does the arid-land subterranean termite.

Swarming of eastern subterranean termites usually occurs in April or May, although it may occur much earlier indoors. Several swarms may occur from the same colony; usually the first swarm is the largest. Males and females usually come out in equal numbers.

Species of subterranean termites that don't often occur in Utah include *Reticulitermes virginicus* and *Reticulitermes hageni*. Habits of these species are similar to other subterranean termites found in Utah.

DETECTION OF TERMITES

Subterranean termites remain hidden within the wood or other materials on which they feed. Those actually doing the feeding are seldom seen.

The presence of winged termites emerging from the ground in or near the house doesn't necessarily mean the house is infested. However, it's a good reason to check further. Termites working in homes or other buildings usually come from colonies already established in the soil. Perhaps the termites in a colony beneath the house or in the soil nearby have been feeding on scrap lumber, roots, or tree stumps left in the ground when the house was built.

Other signs of infestation are the presence of flattened, earthen shelter tubes that termites build over the surface of foundations to reach wood. This habit is more commonly seen among the eastern subterranean termites; the native and land subterranean termites have smaller colonies, so fewer tubes are made. These mud tubes are usually one-fourth to one inch wide. Since termites are very sensitive to drying conditions, mud tubes are built to maintain high humidity throughout the colony.

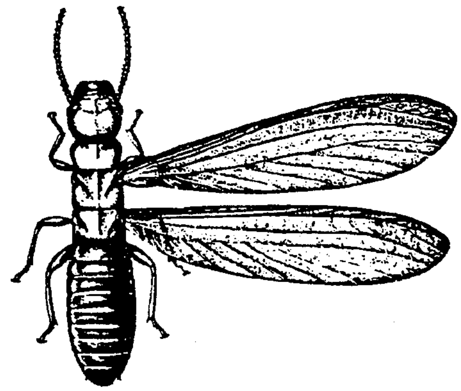
Houses in areas where termites are common should be inspected at least once a year for evidence of tubes. In concrete-slab floor construction, examine closely the cracks and places where pipes and ducts go through the slab.

Damaged wood often isn't noticed, and the exterior surface usually must be removed to see the damage. However, galleries can be detected by tapping the wood every few inches with the handle of a screwdriver. Damaged wood sounds hollow, and the screwdriver may even break through into the galleries. Subterranean-termite feeding follows the grain of the wood, and only the soft spring wood is attacked. They build galleries in wood containing sand and soil particles that are used as a form of plaster. Subterranean termites don't push wood particles or pellets (fecal material) outside of tunnels (a habit of wood-boring beetles and carpenter ants), instead eating it as food.

Sand, dirt, and fecal material may fall off termite tubes due to normal vibrations within a structure. This material will collect in small piles or may be caught in spider webs below the termite tubes. Evidence of infestation of this type should be looked for when doing a termite inspection.

DRY-WOOD TERMITES

Dry-wood termites (*Incistermes sp.*) live and feed in dry, sound wood. They require no contact with the ground or other moisture source. What moisture they require must come from the wood they inhabit and eat. They can be extremely damaging and are serious pests in the southwestern United States. Fortunately, infestations in Utah are rare. Dry-wood-termite injury is most common in furniture, attics, utility poles, and a variety of dry wood products.



Dry-wood termite

Because their individual colonies are small, dry-wood termites generally take longer to produce severe structural damage to homes than subterranean termites.

The first evidence of dry-wood-termite infestations is usually piles of fecal pellets. They vary in color from light gray to very dark brown, depending on the wood being eaten. The pellets are hard, elongated and less than one-twenty-fifth inch in length, with rounded ends and six flattened or cupped sides. **Pellets produced by dry-wood termites may resemble those produced by anobiid and bostrichid beetles.**

There is generally very little external evidence of dry-wood-termite infestations. Exterior openings are closed with a secretion and pellets when their use is completed. Dry-wood termites work just under the surface of wood, leaving a very thin veneerlike layer. Probing with a sharp instrument or pounding the surface may reveal hidden damage. Dry-wood termites are non-subterranean termites; they don't live in the ground, and they don't build mud tubes. The colonies are located in the wood they eat and are small in size when compared to subterranean termite colonies.

In size, dry-wood termites are generally larger than subterranean termites. The primary physical differences between the two insects are their wings. Dry-wood termites are characterized by having distinct longitudinal veins with many cross-veins along the front of the wing.

DAMP-WOOD TERMITES

Damp-wood termites are most often found in Pacific Coast states, including northern California and western Oregon and Washington. As their name implies, they are generally found in damp, sometimes decaying wood. Damp-wood termites usually enter Utah transported on wood from the Pacific Northwest. There is no evidence that damp-wood termites have ever become established in Utah or are likely to survive in our arid climate.

CONTROL OF SUBTERRANEAN TERMITES

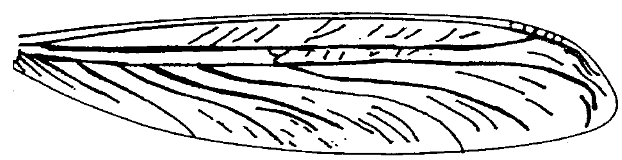
Subterranean-termite attacks on structures may be disrupted and prevented by establishing a barrier of termiticide-treated soil through which they can’t pass without lethal contact. Pesticide-application techniques now used in termite control include low-pressure spray application, trenching, rodding, and sub-slab injection. Skill in using these techniques, knowledge of construction techniques, effects of soil characteristics and grading, location of moisture sources, biology, and behavior of the termite species are among the factors needed to effectively treat termite infestations.

Termite control begins with a thorough inspection of the structure and the preparation of a "to-scale" graph of the structure's foundation, any floors that show either termite activity or damage, and whether it’s active or inactive (old). The graph should include, if applicable, the following, in addition to any treatment specifications or instructions:

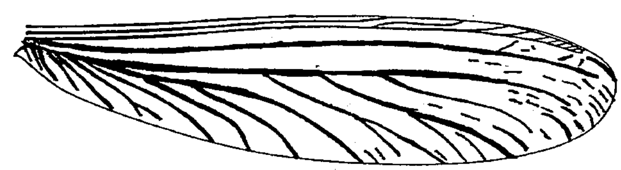
1. Dimensions of the structure.
2. Type of foundation wall(s).
3. Depth from soil grade to footer.
4. Location of plumbing lines and/or penetration for slabs.
5. Type of heating system (for slab).
6. Location of cracks and/or expansion joints in the foundation or slab.
7. Types of floor-covering on concrete slabs that require drilling (carpet, wood, linoleum or tile).
8. Type of porches present (slab/dirt-filled).
9. Location of any well or cistern, if present.
10. Whether or not adequate ventilation is present (for crawl spaces).
11. Location of excessive moisture.
12. Location of wood-to-ground contacts.
13. Location of excessive moisture.
14. Location of active termite infestations.
15. Location of old termite activity.
16. Location of termite damage.
17. Location of any possible hidden termite damage.

PREVENTION

The principal food of termites is cellulose obtained from wood and other plant tissues. Termites, therefore, feed on wooden portions of buildings, utility poles, fence posts, or any other wood product. They also damage paper, fiberboard, and various types of fabrics derived from cotton and other plants. Many non-cellulose materials, including plastics and sheetrock, may be penetrated and damaged by termites, although they don’t serve as food.



SUBTERRANEAN TERMITES



DRYWOOD TERMITES

Cutting off ground contact and soil moisture is the main principle in subterranean-termite prevention and control. Usually, simple structural modification may be all that is necessary to achieve effective control.

Ventilation openings in foundation walls beneath buildings with crawl spaces should be large enough and properly located to prevent dead-air pockets from forming. These pockets are conducive to humid conditions that favor termite activity. Openings within ten feet of the corners of buildings usually give the best cross-ventilation. Openings need not be placed on the front of a building, provided they can be arranged to prevent unventilated areas. The size and number of openings depend on soil moisture, humidity, and air movement. In general, the free area of a ventilation opening should be equal to 1/150 of the ground area beneath dwellings. Keep shrubbery far enough from the foundation to allow inspection of wall surfaces for the presence of termite tubes.

Use of chemically treated wood is an additional safeguard against damage from termites and decay. For maximum protection, the wood should be pressure-impregnated with an approved chemical by a standard process. Vacuum treatment gives adequate protection where conditions are less severe. Brush, spray, or short-period-soak treatments give limited protection to wood above ground. Slow-growing heartwood of some native wood species is quite resistant to termites, but it isn't totally immune nor is it as resistant as pressure-treated wood. The following kinds and grades of lumber are considered the most resistant to native termites:

1. Foundation-grade California redwood.
2. All-heart southern tidewater red cypress.
3. Very pitchy southern pine "lightwood."
4. Heartwood of eastern red cedar (less resistant than other three listed above).

Consider sanitation and structural control measures first, not only for prevention but also to control existing infestations. These measures include:

1. Remove all wood, including form boards and other debris containing cellulose, from underneath and adjacent to buildings with crawl spaces.
2. Remove soil from contact with any wood of the building. Where possible, remove all soil within 12 inches of floor joists. Establish new grades to provide good drainage.
3. Replace heavily damaged wood with sound material or masonry. Substitute metal or masonry where wood is in contact with the soil.
4. Remove other wooden units such as trellises that connect the ground with woodwork on building exterior.
5. Fill voids, cracks, or expansion joints in concrete or masonry with either cement grout or roofing-grade coal-tar pitch.
6. Provide adequate drainage. Moisture correction may range from repair of drainage downspouts, eaves, and leaky taps to grade improvement.

CHEMICAL TREATMENT

Subterranean-termite attacks on structures may be disrupted and prevented by establishing a barrier of pesticide-treated soil through which they can't pass. Pesticide-application techniques now used in termite control include low-pressure spray application, trenching, rodding, and sub-slab injection.

Skill in using these techniques includes:

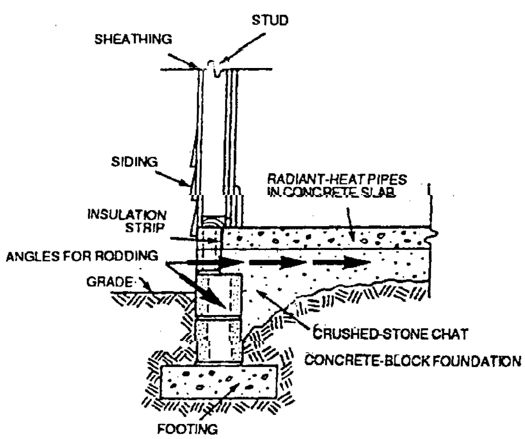
- A knowledge of the relationships of construction
- Soil texture
- Soil compaction
- Grade conditions
- Water table
- Location and type of domestic water supplies
- Biology and behavior of the termite species
- Suspected location of the termite colony
- Severity of infestation

These skills are important factors in the safe and effective use of a pesticide for termite control.

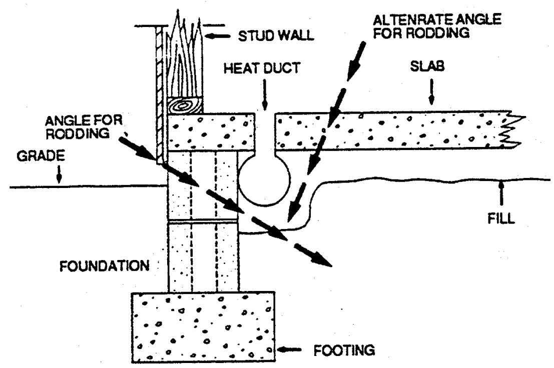
Low-pressure spray application of pesticides is generally used when the pesticide is applied to the soil surface as in overall treatment of the area beneath a slab (pre-construction) and in treating the interior and exterior walls of foundations with shallow footings.

Trenching involves excavation of soil in an area six inches wide adjacent to and around all piers and pipes and along both the inside and outside of foundation walls. For a poured concrete foundation, a trench three to six inches deep may be adequate; trenching around brick and hollow block masonry foundations should be at least 12 inches deep. Apply the pesticide in the trench and to the backfill in the manner described on the pesticide label.

Rodding involves the use of rods usually made of one-fourth- to one-half-inch diameter pipe about four feet long and equipped with a handle and shut-off valve. The other end of the rod is fitted with a tip with holes so that pesticide flows out in different directions. Soil penetration is aided by pre-wetting the soil. Pesticide flow begun after the tip of the rod is forced into the soil aids in the passage of the rod. High pressure isn't necessary -- two to five pounds is often used. Frequency of rodding varies with soil conditions (usually about every 12 inches, but sometimes as close as six inches in clay to as much as 18 inches in sand). Place rods about six inches from the wall, never further than 12 inches, and with the point of the rod angling slightly toward the foundation so the flow is directed against it. Extreme care must be used to avoid hitting heat/air ducts.



Sub-slab injection involves the use of a special tool, the sub-slab injector, inserted through holes drilled in the concrete slab to introduce the pesticide into the soil beneath the slab. Mainly for use inside structures, but for outside use as well, the sub-slab injector may be equipped with a rubber seal to avoid spills. In using the sub-slab injector, drill holes through the concrete slab, taking care to avoid drilling into electrical conduits and plumbing. There's always a chance of drilling into a gas line, water line, electrical wiring, or heating ducts. Care should also be taken, when drilling, not to go beyond the bottom of the slab and into the soil. A sub-slab soil hole can lead to poor or uneven distribution of pesticide beneath the slab.



HAZARDS ASSOCIATED WITH TREATING SLABS

In structures that have heating ducts under or within the foundation slab, it's possible for power-drill bits to enter the duct without being detected by the pesticide-control official (PCO) doing the drilling. When the termiticide is injected, it enters the ducts and is picked up when air is forced through the heating system.

In older homes with slab heating systems, the heating ducts are built of materials that may decay, crack or split over time. When this happens and an application of the termiticide is made, it can enter the ducts, and insecticide vapor can be blown into the heating system, where people may be exposed to the contamination. Because of the problems inherent in this type of heating system construction, especially in houses built in the early 1950s, there's an increased risk of exposure.

The vast majority of certified PCOs are aware of the dangers of termiticide applications to houses with heating ducts within or under slab foundation. The PCO treating such structures knows that extra caution is needed in applying any termiticide, especially when applied under pressure to a structure. Some houses with this construction can't be safely treated for termites unless the duct system is sealed and relocated above the ground.

If contamination of heating ducts with termiticides occurs, the PCO should seek help from the termiticide manufacturer in decontaminating the structure. In certain situations, it may be necessary to seal the old ducts and install an above-slab system (attic ducts).

Owners of buildings with slab construction and heating systems within or under slabs should give the PCO a diagram showing the location of the heating ducts. The condition of the duct system should be verified before any termiticide is applied.

Know where all utility shutoff points are before drilling. Structures with electrical conduit or hot-water heat installed in the slab can be very hard to treat. A grounding device on drilling equipment is always desirable. Raised porches, terraces, entrance slabs, sidewalks and driveways, either filled with soil or on soil, may be treated by using sub-slab injection. Holes are drilled about 12 inches apart to permit injection of pesticide into the soil. Appearance of pesticide in holes adjacent to the injection site may be used as a guide to coverage and distribution. At times, it’s necessary to inject the pesticide through exterior foundation walls just beneath the slab, a method often employed under kitchens and bathrooms. This method is more complicated and requires use of horizontal rods.

The many construction variations preclude a detailed discussion of the use of these techniques in applying pesticides; however, most pesticide product labels provide specific information about amounts of pesticide to use and application methods (low-pressure spray, trenching, rodding, etc.) for various types of construction and re-construction.

EFFECTS OF SOIL ON PESTICIDE MOVEMENT

Ease of movement of air and water into and within a soil (permeability) may be estimated by soil texture. Generally, the greater the relative amount of small-size particles (clay and silt), the less permeable the soil. However, organic matter, salts, and other soil factors may affect soil permeability and movement of pesticides applied to the soil. Soil structure also is important to soil permeability. Generally, the more well-developed and stable the structure, the better the permeability.

Pesticides move in soils in the same direction as water. However, the rate of movement is affected by many things, including the chemical structure of the pesticide and the soil characteristics. Most currently used termiticides move very slowly in clay soils. Clays retain pesticides by chemically binding to them, a process known as **adsorption**. On the other hand, sandy soils don’t retain pesticides, and pesticide soil movement can greatly increase at these sites. Also, rock formations have poor adsorption characteristics and may allow movement of the pesticide along fractures. In these rock fractures, water may carry pesticides rapidly.

A compacted soil is one in which larger pores (voids) are reduced in size as the soil particles are forced closer together. Compaction often occurs when heavy equipment moves over the soil surface, destroying natural structures and forcing soil particles together. The overall porosity or openness of the soil is thus reduced, increasing the relative proportion of fine pores and reducing movement (permeability) of air and water into and within the compacted soil.

On the other hand, high-clay, compacted soils may sometimes crack. Where this happens, flow of water, and
pesticides carried by it, is greatly increased.

PROTECTION OF GROUNDWATER AND WELLS DURING TERMITICIDE APPLICATION

Limited movement of air and water within soils, whether because of soil texture, soil compaction or both, requires greater care and effort in applying pesticides to create an effective barrier. On the other hand, relatively unrestricted or free movement of water and air within a soil may signal the need for special care, especially in situations where wells, cisterns, springs, or water tables are a concern. The most common cause of well contamination is faulty sealing of the well. This permits surface water to enter the well, usually along the pipes leading into the dwelling. Also, old cisterns or dug wells that haven’t been properly filled can accumulate insecticides, and these can seep into the existing water supply.

Unusual fill problems or changes in surface or subsurface grades may permit chemicals to move by concealed routes to the well. Tree roots often reach to water sources. These may be direct channels for insecticides to follow.

Structures with wells located within the foundation aren't acceptable for treatment. Always discuss these special situations with a property owner.

Chemical treatment where wells or cisterns are present must use special techniques such as treated backfills, polyethylene lining, wood treating, gravity application, spot treatment, or reduced amounts of termiticide.

If wells, cisterns, springs, or high water-tables are located near the area of soil treatment, special precautions are required. Consult FHA, state and local regulations before applying any pesticide for termite control, complying both with regulations and the product label. High water-tables may exist in some areas of the state, especially in low-lying areas. Many, however, may be perched water-tables of a temporary nature occurring mainly during periods of extended rainfall. Water contamination may occur through flooding layers of gravel in the soil or through pesticide movement within underground channels such as those left by tree roots or ones formed in soils that crack severely during a drought. The following procedures may be useful in reducing the possibility of contamination:

! Use mechanical alteration as much as possible. Such work is expensive, and its effectiveness can't be taken for granted. Frequent inspection is advisable.
! Place increased emphasis on wood treatment. Paste or gel formulations may be easily applied by brush from bulk containers or are available in tubes for use in caulking guns. The caulking-gun application is the handiest method. Frequent inspection for re-infestation is advisable.
! Chemically treat structures near wells and cisterns only where passage of termites from soil to the building is known to exist or is highly probable.
! Be especially careful to apply only the amount of chemical needed. Avoid flooding and runoff!
! If foundations are being treated, apply a smaller amount for each void. Don't permit runoff!
! Where permissible, treat structures near a well by removing the soil from around the foundation to a remote area, treating it thoroughly and allowing it to dry completely before replacing it. Place plastic sheeting in the trench to hold the treated soil against the foundation. This will help protect against contamination of the water supply.

PRE-CONSTRUCTION TREATMENT

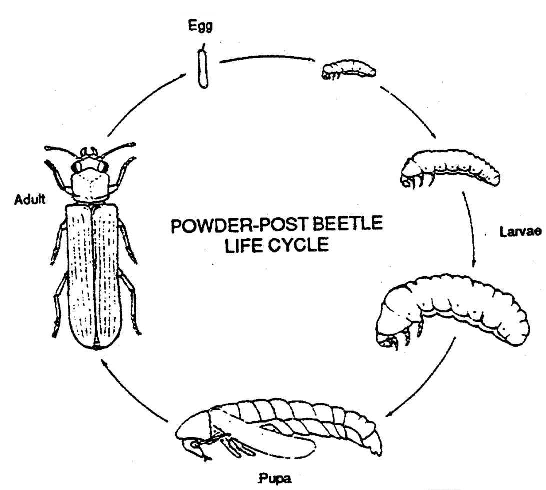
Termiticide applications can be most easily and effectively applied during early stages of construction. Areas to receive applications are exposed, allowing more thorough treatment.

WOOD-BORING BEETLES

There are many wood-boring beetles of occasional importance to pest-control operators in Utah. They are the
true powder-post beetles, false powder-post beetles, and furniture beetles. There are of course, many other beetle species found in homes and other structures that we don't have room to discuss in this manual.

THE POWDER-POST BEETLES

The true powder-post beetles (Lyctidae) are a group of beetles that infest hardwoods **only**. Wood with large pores such as ash and red oak are most commonly infested. Hardwood baseboards, oak beams, tool handles, gun stocks, and hardwood furniture are typical places where infestations occur. New wood (less than ten years old) is much more commonly infested than is older wood.



Adults are attracted to light after emergence from infested wood and collect on window sills. Adult beetles are about one-fifth of an inch long and generally thin and flat in shape. They are reddish-brown to black and can be mistaken for a red flour beetle, a common insect found infesting flour in pantries. The head is visible from the dorsal (top) view. The larval burrows follow the grain of the wood and don't branch. They occur in the sapwood only. The exit holes resemble "shot holes" about one to two millimeters in diameter and are made by the adult beetle.

Life History and Damage

Damage to wood by the powder-post is distinctive. A common indicator of an infestation is the small (one-thirty-second- to one-eighth-inch diameter) holes made in the wood when adult beetles emerge. Also the sawdust frass (excrement) produced by these wood-boring beetles is extremely fine and powdery. **This fine powderlike sawdust is the most distinctive evidence of powder-post-beetle infestation**. It piles underneath existing exit holes and falls easily from the feeding channels when a piece of wood is tapped in an upside-down position. Piles of sawdust frass often accumulate at the base of infested wood. Other types of wood-boring beetles, carpenter ants, and dry-wood termites leave pellets or a coarse, stringy material or may pack their excrement tightly into the channel.

The immature stages (larvae) of the wood-boring beetles are almost entirely responsible for wood injury. Powder-post-beetle larvae feed on the starch-rich sapwood and tunnel through it extensively. Damage is limited to wood with large pores -- hardwoods such as oak and ash. Also, bamboo can be infested by powder-post beetles. However, softwoods such as pine and Douglas-fir aren't attacked by powder-post beetles.

Eggs of the powder-post beetle are usually laid shallowly in the exposed pores at the ends of cut wood. Some eggs are also laid within cracks in the wood or at the mouth of old exit holes.

After hatching, the larvae tunnel through the sapwood, rarely forming branches across the wood. Development of these wood-borer larvae requires as little as three to four months under favorable conditions but often takes a year or more. Within the wood, there may be little or no external evidence of infestation. After the larvae have finished feeding, they tunnel close to the wood surface to pupate. The adult beetles later emerge from the wood to mate, lay eggs, and continue the infestation.

Some powder-post and anobiid beetles that infest wood in Utah also occur outdoors, where they naturally infest dead wood, especially smaller branches. However, most Utah infestations appear to originate from infested lumber or furniture originating in eastern states, where the insects are more common.

Control

Infestations of powder-post beetles are slow to develop and progress. Also, infestations often die out on their own, without intervention, as the wood dries. Drying of wood below eight- to 12-percent moisture may also prevent beetles from developing. Therefore, there is rarely a need for haste in treatment.

Wood can be made unsuitable for egg-laying by finishing it with paint, shellac, or other coverings. Special attention should be paid to covering the ends of wood, where most egg-laying occurs in exposed pores. This treatment doesn't kill larvae within wood but can prevent subsequent re-infestations. However, emerging beetles also create new openings in the wood, and these openings also have to be covered. Re-application of the finish may be necessary to maintain protection.

Wood that is already infested can be removed and replaced or treated to prevent re-infestation. Certain formulations of insecticides containing chlorpyrifos (such as Dursban LO) are registered for this purpose. The application can be made either as a coarse spray or brushed onto the wood. Some larvae within the wood may be killed by this treatment, although the main effects are on adult beetles before they lay their eggs. Effectiveness of the treatments for larval control is reduced in wood that exceeds one-inch diameters and in finished wood.

Valuable items that are hard to treat with insecticides may need to be fumigated for control. Several hours' exposure to high temperatures (above 130 degrees F.) can also kill larvae in infested wood. However, these heat-treatments are often not desirable, since they can warp the wood and damage finishes. In areas of extreme cold winter temperatures, infested items may be treated by exposure of the wood to temperatures below 0 degrees F. for several weeks.

Abruptly exposing the infested materials from alternating warm conditions to cool conditions is important in effectiveness of cold treatments.

FALSE POWDER-POST BEETLES

The false powder-post beetles (Bostrichidae) are a diverse group that varies in size, color, and other characteristics. Typically, the false powder-post beetles are cylindrical in shape with their heads tucked under their thorax so that the head isn't readily observable from the dorsal (top) view.

Normally, bostrichid beetles produce stringy, sawdustlike frass packed tightly into the larval channels. Tunnels in the wood often go across the grain.

The adult beetle bores to the outside, leaving an exit hole larger than that of the lyctid beetle. Typical items infested are picture frames, bamboo, hardwood furniture, and some kinds of paneling. Usually these items were bought and brought into the house already infested. The increased temperature inside the house causes the beetles to become active.

ANOBIID (FURNITURE) BEETLES

Powder-post (Lyctidae) beetles are more common than anobiid beetles (Anobidiidae) or bostrichid beetles in Utah. Typically they are found attacking soft-wood products. The larvae are white with black jaws. They produce frass that consists of small, blunt-ended pellets, which resemble small lemons when examined under a l0-30x scope or hand lens.

Anobiid beetles develop slowly in wood. One to three years are required to complete development of a generation. Damage and habits caused by anobiid beetles are similar in many ways to that of powder-post beetles. Damage is caused by the immature larvae that tunnel in the sapwood. Adult beetles that emerge from the wood produce small exit holes similar in size to that of powder-post beetles.

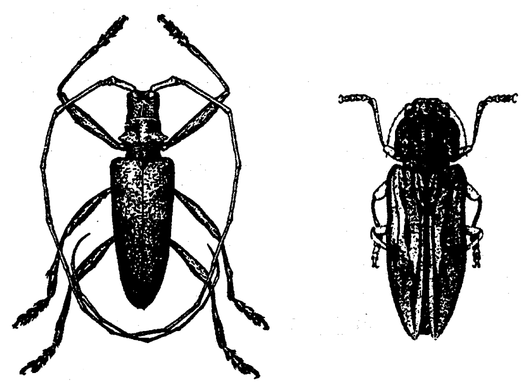
Control of anobiid beetles is similar to that for powder-post beetles. Anobiid beetles are even more sensitive to drying than are powder-post beetles, being limited to damp, poorly ventilated areas. When high-moisture conditions are corrected, infestations normally die out under Utah conditions.

WOOD BORERS

Large wood-boring beetles may occur in firewood, house logs, or recently felled timber turned into structural timbers. Several round-headed borers (larvae of long-horned beetles) and flat headed borers (larvae of metallic wood borers) are native to the state and commonly infest firewood or felled logs.

Wood borers produce a lot of stringy frass that they often push out of tunnels to form piles. Chewing may be quite noticeable and annoying. In addition, adult stages of the insects are quite noticeable and may cause concern when they emerge. Several wasps that attack the beetle larvae also may emerge from the borer-infested wood.

The wood borers found in Utah can only re-infest (successfully lay eggs) in wood with the bark intact and that isn't extremely dry. Larvae occurring in wood, however, may live from one to four years.



Wood-boring beetles

Wood borers are a nuisance problem. Very little structural damage occurs to wood products from these insects in Utah.

The old-house borer, a round-headed borer that attacks structural timber in the eastern United States, occurs rarely, if at all, in Utah.

Control

Problems with wood borers in structures are usually self-limiting, dying out without intervention after the generation completes its life cycle.

Use of well-dried or pressure-treated wood can kill existing borers within wood. Wood without intact bark isn't susceptible to future attack.

Firewood should never be stored in living areas for extended periods. Indoor storage allows favorable conditions for wood borers to complete development and emerge within the house. Although they don't cause serious injury, they typically create concern. Most indoor beetle emergence can be avoided by storing firewood outdoors.

CARPENTER ANTS

The carpenter ant occurs widely in the United States and is one of the largest of our common ants. The adults vary in length from one-fourth inch for small workers to three-fourth inch for a queen. The body is dark brown to black.

Carpenter ants seek soft, generally moist wood to establish their nests, especially wood that has weathered and begun to decay. Although the nest is most often started in the soft wood, later excavations often are made into perfectly sound, dry lumber. They may be found in porch columns and roofs, window sills, hollow-core doors, wood scraps in dirt-filled slab porches, and wood in contact with soil.

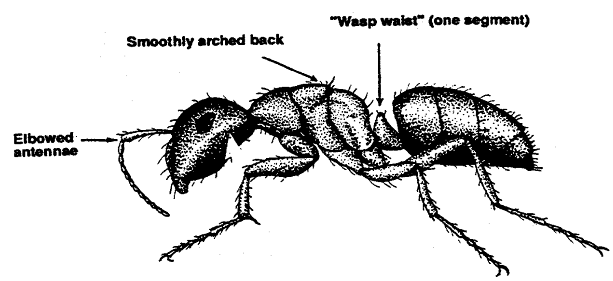
Carpenter ants don't eat wood (as happens with termites) but excavate galleries in the wood to rear their young. Carpenter ants eject the wood as coarse sawdust. The characteristic sawdust piles aid in nest location. They feed on honeydew excreted by aphids, other insects, animal remains, and household food scraps. The work of carpenter ants is easily distinguished from that of termites. Their galleries are excavated without regard for the grain and follow the softer portions of the wood. The galleries are kept smooth and clean, having a sandpapered appearance. Termite galleries aren't smooth and clean.

CONTROL OF CARPENTER ANTS

Effective control of carpenter ants is dependent on finding the nest. When carpenter ants are found in a building, they are nesting either inside the building or outside the building and entering to forage for food. In some circumstances, an entire colony may migrate from one nesting site to another, so it's important to eliminate the nest outdoors AND the one indoors. Houses near wooded areas are especially subject to an invasion. Individual carpenter ants are great wanderers, traveling as far as 300 feet. They are often found in homes.

A thorough inspection of the building and the grounds is important, because more than one colony may be involved. The inspection should include an interview with the residents, inspection indoors, inspection outdoors, and sound detection.

The interview with the residents should be used to get information on where the ants have been seen, where they are most prevalent, patterns of their movement, and whether swarmers or sawdust-like materials have been seen. Moisture problems in the building should be determined, because carpenter ants strike in these areas.



Carpenter-ant worker

The indoor inspection should concentrate on looking for areas of wood associated with high moisture. Critical areas include plugged drain gutters, poorly fitted or damaged siding and flashing, wood-shingle roofs, hollow porch posts and columns, leaking doors, and window frames. Look for wood in contact with soil and wood in crawl spaces or under dirt-filled slab porches.

Sometimes carpenter ants will be found in a perfectly dry environment. Nests may be found in hollow veneer doors and small void areas, such as the space between the top of a door casing and the ceiling. In many of these cases, the wood isn't mined; the ants are merely using existing cavities.

When looking for a nest indoors, look for:

1. **Piles of wood debris ejected from a colony**. This debris has a shredded quality that looks somewhat like shavings found in pencil sharpeners. Sometimes this debris is deposited in voids in the wall and isn't visible.
2. **"Windows" or small openings to the nest**. Windows may not always be present, since existing cracks may be used by the ants.
3. **Ant activity**. Ants often forage in the kitchen pantries, etc., for food. Few ants are seen during the day, as they are more active at night.
4. **Swarmers**. They may be trapped in spider webs.
5. **Damaged timbers**. The surface may appear solid, but by sounding, damaged areas can be located.

Outdoor inspection includes a thorough inspection of the structure and the grounds. Carpenter ants commonly nest in trees and stumps and use branches and vines to travel. While they may nest in living trees, they are more commonly associated with knotholes, scars, dead areas, and crotch areas. Firewood is another possible nesting site. Look for areas outdoors where a moisture problem may exist or did exist at one time.

Sound detection is sometimes useful in carpenter-ant nest location. An active colony at times produces a distinct, dry rustling sound that may be heard from outside the nest. The sound isn't related to chewing wood. It's thought to be a means of communication and intensifies if the colony is disturbed. Sometimes it's very loud, but generally it can only be heard when conditions are very still and outside noises are at a minimum.

Protection of structures from carpenter ants requires destruction of ants in all colonies both in or near the structure.

Control indoors -- The steps to be taken are twofold:

1. Eliminate high-moisture conditions to aid carpenter ant control and to prevent future attacks.
2. Apply insecticides to nesting areas. Dusts are especially effective in treating nest galleries. They may be used with sprays.

Spraying or dusting the infested area with residual insecticides without locating or treating the nest usually doesn't result in complete control. The foraging workers may contact the insecticide and die; however, some ants confine their activities inside the galleries of the nest and survive. The queen and developing larvae wouldn't be affected. Individual carpenter ants can live more than six months without feeding, so it becomes obvious that galleries of the nest must be treated.

Insecticides should be applied to extensively permeate areas inhabited or traveled by the ants. The extent of the galleries should be determined by careful inspection, and it's often helpful to bore small inspection holes at 12-inch intervals in the infested timbers to intercept the cavities and galleries of the nest. Void areas may be drilled into in the same manner. The spray or dust can then be applied by using a nozzle that will fit tightly into these holes. The sprayer or duster should be of a type that will force the insecticide into and through the different chambers. Care must be exercised when using liquid insecticides so that the fluid doesn't leak through and stain surfaces adjacent to the treated areas. Holes may then be sealed by hammering in dowels (as plugs) or small corks of appropriate size.

Approaches and areas adjacent to the nest should also be thoroughly treated with residual insecticides.

Control Outdoors -- Control outdoors is most successful if residual insecticides are applied directly in the nests. Water emulsions or wettable powders generally are preferred to oil solutions, however, because of the toxicity of the oil carriers to vegetation.

BEES AND WASPS

LEAFCUTTER BEES

Several species of leafcutter bees are native to Utah. These insects form nests in existing cavities or excavate soft wood and plant pith. The adult bees then fill these nests with pollen and nectar on which the young bees develop.

Leafcutter bees do attack sound wood but cause little structural damage. They are also quite non-aggressive. Stings are rare and much less painful than those caused by honeybees or paper wasps.

CARPENTER BEE

Carpenter bees are large, black and yellow insects, about one inch long, and resemble bumblebees. However, unlike bumblebees, carpenter bees nest in wood, in which they excavate tunnels. These tunnels are used for rearing the young bees, which feed on pollen and regurgitated nectar provided by the female. Although able to sting and appearing rather fearsome, carpenter bees are quite docile and sting only under very unusual circumstances, such as when trapped in clothing.

Structural damage caused by one or two carpenter bees is slight. However, tunnels may be used again and lengthened by other broods. The activities of numerous bees over a period of years can cause significant structural damage. Fortunately, carpenter-bee problems are quite rare in Utah.

Painted wood is rarely attacked by carpenter bees, so keep all exposed wood surfaces well-painted. However, wood stains won't prevent attacks. Wood that is pressure-treated with a preservative can be used if painting isn't practical.

Control can also involve application of insecticide dust into the tunnel entrance. Treat the opening after dark, when the bees are less active. Don't plug the holes, but allow the bees to pass freely so they can contact the insecticide. Reapply the insecticide to the entrance holes in August to kill any newly emerging bees. The holes can later be filled at the end of the season.

WOOD-DECAYING FUNGI

Decay fungi are fungi that use the structural part of wood (cell walls) for food. These fungi produce special enzymes that can destroy cell-wall materials such as cellulose, hemicellulose and lignin. This can reduce the structural strength of the wood and, in serious cases, render the wood completely unfit for construction.

Severe wood decay occurs only in wood with a moisture content greater than 20 percent. Most wood-rotting fungi grow only on wood subject to wetting by rain, roof leaks, plumbing leaks, condensation, or contact with moist soil. However, the dry-rot group of fungi can conduct water from the air, allowing it to attack drier wood. Common groups of wood-decay fungi include:

Cubical brown rot. This rot causes the wood to break into small cubes with cracks running perpendicular to the grain. This condition is caused by recurring changes in moisture content from wet to dry. The wood becomes brittle, and shrinkage occurs because of these moisture changes. The cellulose of the wood is destroyed, leaving the lignin and producing a brown, crumbly material. The strength of the wood decreases rapidly, and it can be crushed into a powder.

White rot. Fungi that cause white rot attack not only cellulose, but also lignin. Destruction of the lignin results in a whitish, bleached appearance. The wood has a stringy texture and sponge consistency. Wood with white rot loses its strength much more gradually than occurs with cubical brown rot, and shrinkage is rare. White rot is common in areas that are consistently wet.

Dry rot. Dry rot fungi are types of brown rot fungi that can conduct water into the wood. As a result, wood that is immune from attack by other fungi may be attacked by dry-rotting fungi. This is achieved by means of vinelike structures called rhizomorphs, which can move water from moist soil or wood into dry wood. The rhizomorphs are dirty-white and become brown or black with age.

Blue-stain fungi. Blue-stain fungi are a group of fungi that don't cause decay. Instead of destroying cell walls, the fungi develop within the cells of the sapwood, causing a bluish or bluish-gray stain. Although they don't cause structural damage, they can make wood more susceptible to damage by decay fungi.

Blue-stain fungi are commonly associated with various bark beetles that attack stressed or declining stands of timber. In Utah, the most common blue-stain fungi are those transmitted to pines by the mountain-pine beetle or to Douglas fir by the Douglas-fir beetle. In the forest, the fungus actually helps the beetles by killing or reducing the vigor of the trees, making it more suitable for the beetle larvae to develop. In lumber, both the beetle larvae and the blue-stain fungi cease to develop further. Furthermore, the blue staining is sometimes considered attractive, with stained wood receiving special use in paneling.

CONTROL OF WOOD-DESTROYING FUNGI

All fungi that grow on wood have certain basic requirements: a food source, favorable temperature, and adequate oxygen and moisture. A deficiency in any of these requirements will inhibit the growth of a fungus, although it may be well-established in the wood.

The most practical method of controlling fungi in structures is to control the moisture content of wood. Methods of moisture control include:

1. Isolating wood from soil.
2. Installing moisture barriers.
3. Providing adequate ventilation.
4. Improving drainage.
5. Applying chemical preservatives.

The following checklist can be used as a guide in helping avoid problems with decay fungi and/or termites:

CHECKLIST FOR DECAY PROBLEMS

1. Flower beds next to the house. Soil should not touch wood siding.
2. Soil grading. Wood should be at least three inches above adjacent finish grades for framing members, six inches above finish grade for siding.
3. Lawn sprinklers. Persistent wetting of exterior wood creates a high decay hazard.
4. Wood junctions. Decay lurks especially where boards or beams are jointed, end to end. Also, the ends of boards or beams absorb water much more rapidly than do the sides. Metal caps help prevent decay.
5. Ends of exposed beams. Cracks that open as wood dries out permit serious rain-wetting. Exposed beams should be treated with a preservative. When completely dry, ends should be capped with a metal cap.
6. Roof overhangs. A wide overhang moves water runoff away from exterior walls.
7. Roof dormer and chimney. Flashing must be used between roof and dormer.
8. Roof lines. Water should flow away from the house.
9. Roof edges. If shingles don't extend enough beyond fascia board, water that curls under the shingle will drain over wood trim at roof edges. Metal edging allows drip line from roof to clear wood trim.
10. Splashing rain. Special hazards: rain from roof falling onto a hard surface like a patio. Install rain gutters with downspouts that direct the drainage away from the house.
11. Porch areas. Porch surfaces must slope away from house to avoid water collection.
12. Wooden posts. Be sure posts don't touch the porch surface. Direct flowing water away from posts.
13. Plumbing leaks. Stop leaks behind washing machines, leaks around the bathtub or toilet, and leaks in the shower.
14. Condensation underneath the house. Some houses need a vapor barrier between the ground and the house.
15. Water collecting under the house. Fill holes and make water drain away from the house.

WOOD PRESERVATIVES

The proper application of chemical preservatives can protect wood from decay and stain fungi, insects, and marine borers, thus prolonging the service life of wood for many years.

The effectiveness of wood-preservative treatment depends on the chemical formulation selected, method of application, proportion of sapwood to heartwood, moisture content of the wood, amounts of preservative retained, depth of chemical penetration and distribution. Sapwood of most commercial species accepts preservatives much better than heartwood, and softwood species are generally more receptive to impregnation than the hardwoods. Preservative treatment by pressure is still required for most wood products used for structural and other applications exposed to high risk of attack by fungi, insects, or marine borers.

TYPES OF PRESERVATIVES

Wood preservatives fall into three broad categories:

1. Creosote and creosote solutions
2. Oil-borne preservatives
3. Water-borne preservatives

Creosote and creosote solutions are an oily by-product of making coke from bituminous coal. They have been widely used as a preservative for such products as railroad ties, large timbers, fence posts, poles and pilings. Creosote-based preservatives are toxic to wood-destroying fungi, insects, and some marine borers. They are easy to apply and are insoluble in water. Creosote has low volatility and doesn't readily produce fumes. However, creosote treatment of wood results in a dark color with a strong odor. Creosote tends to "bleed," and the wood surface remains oily and unpaintable. Creosote-treated wood can't be used in homes or other living areas.

Oil-borne preservatives include wood preservatives such as pentachlorophenol (penta). These chemicals are generally insoluble in water and must usually be dissolved in organic solvents to penetrate wood. The oil-borne preservatives are toxic to fungi (including mold), insects, plants, animals and humans. However, for some applications, these preservatives provide less physical protection than does creosote. Treated wood can have an unpaintable surface (depending on the carrier) and produce toxic fumes. Wood treated with oil-borne preservatives shouldn't be used in homes or other living areas.

Water-borne preservatives include various metallic salts and other compounds. The principal compounds used are combinations of copper, chromium, arsenic and fluoride. Water-borne preservatives have gained increasingly wider usage for lumber, plywood, fence posts, poles, pilings and timbers. The treated wood surface is left clean, paintable, and free of objectionable odors. The water-borne preservatives also resist leaching and can be used in living areas or for playground equipment. The preservative copper-8-quinolinolate also has been approved for food-contact uses such as boxes, crates, and pallets used in the harvesting, storage and transportation of food. However, water-borne preservatives don't protect the wood from excessive weathering. They also require that the wood be redried after treatment to prevent warping and checking.

HANDLING AFTER TREATMENT

Treated wood should be handled with sufficient care to avoid cutting or breaking through the treated area and exposing the underlying, untreated wood.

Throwing, dropping or gouging treated wood may cause damage that exposes untreated wood. When damaged in this way, the exposed wood should be retreated. This is usually done by in-place treatment (brushing). When treated wood is machined, thereby exposing untreated wood, such as by boring or cutting the ends of piles, a prescribed preservative should be applied to the exposed wood.

HAZARDS TO APPLICATORS

All handlers of wood preservatives need to know about hazards and necessary precautions. Since risks are directly related to the degree of exposure, most of the risks associated with wood preservatives come from their application and the volatilization that occurs soon after treatment, rather than from use of the treated wood itself. The decision by the EPA to classify the three major wood preservatives (creosote, inorganic arsenicals and pentachlorophenol) as restricted-use pesticides was based on the potential human risk from chronic toxicity (exposure over a long period). Applicators as a group are the people most likely to be exposed over long periods, and consequently need to take precautions as a routine part of working with wood preservatives. Exposure to wood preservatives can occur in a variety of ways: during handling and mixing the chemicals, working around spray or dip operations, handling freshly treated wood, cleaning or servicing equipment, or disposing of wastes.

Since many wood preservatives have a strong odor and taste, it's unlikely a person would swallow a dangerous amount. The more likely forms of exposure are dermal (skin) contact or inhalation of vapors, dust or particles, especially if protective clothing and other precautions are not used.

The reason for the recent restrictions on wood preservatives is based on evidence that there are many potential chronic risks associated with them, including these:

1. Creosote causes cancer in laboratory animals and has been associated with skin cancer in some workers exposed to creosote.
2. Creosote and inorganic arsenicals also cause mutagenic effects (gene defects) in bacteria and laboratory animals.
3. Arsenic has been shown in epidemiology studies to be associated with cancer in humans who either drank water contaminated with arsenic or breathed air containing arsenic.
4. Pentachlorophenol has produced defects in the offspring of laboratory animals.
5. A dioxin contaminant in pentachlorophenol has been shown to cause cancer in laboratory animals.

Besides the hazards of chronic toxicity, a single or short-term exposure can cause the following **acute health effects**:

Creosote -- can cause skin irritation. Vapors and fumes are irritating to the eyes and respiratory tract, and prolonged and repeated exposure may lead to dermatitis.

Pentachlorophenol -- is irritating to the eyes, skin, and respiratory tract. Ingestion of penta solutions, inhalation of concentrated vapors, or excessive skin contact may lead to fever, headache, weakness, dizziness, nausea, and profuse sweating. In extreme cases, coordination loss and convulsion may occur, and high levels of exposure can be fatal. Prolonged exposure can lead to an acnelike skin condition or other skin disorders and may cause damage to the liver, kidneys, or nervous system.

Inorganic arsenical -- exposure to high concentrations of arsenical compounds can cause nausea, headache, diarrhea, and abdominal pain (if material was swallowed). Extreme symptoms can be dizziness, muscle spasms, delirium and convulsion. Prolonged exposure can produce chronic, persistent symptoms of headache, abdominal distress, salivation, low-grade fever, and upper respiratory irritation. Long-term effects can include liver damage, loss of hair and fingernails, anemia, and skin disorders.

Special Precautions for Wood-Preservative Use

A closed system must be used when emptying and mixing prilled, powdered or flaked formulations of pentachlorophenol. When applying pentachlorophenol sprays, the spray equipment must: (1) be operated to minimize over-spray (including no visible mist) and (2) be free of leaks in the system. Should there be a visible mist, spray applicators in the area in which mist is visible must wear respirators and protective clothing (including coveralls, gloves, boots, and head covering) impervious to the wood-treatment formulation, plus goggles.

Exposure to pentachlorophenol during pregnancy should be avoided.

All exposed arsenic-treatment-plant workers are required to wear a respirator if the level of ambient arsenic is unknown or exceeds a Permissible Exposure Limit (PEL) of ten micrograms per cubic meter of air (ug/m3) average over an eight-hour work day. This PEL is the same as the standard required by the Occupational Safety and Health Administration (OSHA). Processes used to apply inorganic arsenical formulation will leave no visible surface deposits on the wood. Small, isolated or infrequent spots of chemical on otherwise clean wood will be allowed.

LIMITATIONS ON USE

Recent EPA regulations on wood preservatives include some limitations on treating wood intended for certain uses. Be sure that the label allows you to use the preservatives for the specific use you intend. Not all these limitations are the responsibility of commercial treaters, but these limitations should be known. The following is a summary of wood-preservative-use limitations:

- Pentachlorophenol and creosote can’t be applied indoors.
- Pentachlorophenol- or creosote-treated wood must not be used in interiors, except millwork (with outdoor surfaces) and support structures that are in contact with the soil in barns, stables, and similar

sites that are subject to decay or insect infestation. A sealer must be applied in those instances.

! Creosote can't be applied to wood intended for use in interiors except for support structures which are in contact with the soil in barns, stables, and similar sites that are subject to decay or insect infestation. Two coats of a sealer must be applied.

! When creosote or pentachlorophenol is applied to wood where it potentially will be exposed to body contact, sealants must be applied to cover the preservative treatment.

THREATENED AND ENDANGERED SPECIES

The Endangered Species Act (ESA) was passed by Congress to protect certain plants and wildlife that are in danger of becoming extinct. This act requires EPA to ensure that these species are protected from pesticides.

Formulation of the Utah Threatened and Endangered Species/Pesticides Plan is a cooperative effort between federal, state, and private agencies and producers/user groups, and is a basis for continuing future efforts to protect threatened and endangered species from pesticides whenever possible. Furthermore, this plan provides agencies direction for management policies, regulations, enforcement and implementation of threatened and endangered species/pesticide strategies.

EPA has therefore launched a major new initiative known as the Endangered Species Labeling Project. The aim is to remove or reduce the threat to threatened and endangered species from pesticide poisoning. EPA has the responsibility to protect wildlife and the environment against hazards posed by pesticides. The ESA is administered by the U.S. Fish and Wildlife Service (FWS) in the U.S. Department of Interior. The Fish and Wildlife Service will determine jeopardy to threatened and endangered species and report to EPA. EPA and FWS will work cooperatively to ensure that there is consistency in their responses to pesticide users and to provide necessary information. The Utah Department of Agriculture and Food is acting under the direction and authority of EPA to carry out the ESA as it relates to the use of pesticides in Utah.

Maps will show the boundaries of all threatened and endangered species habitats in affected counties. The maps identify exactly where, in listed counties, use of active ingredients in certain pesticides is limited or prohibited. Product labels will be updated as necessary. The updated labels will reflect any additions or deletions to the project. Because EPA's approach to the protection of threatened and endangered species was in the proposal phase at the time this guide was published, any and all of the above information on threatened and endangered species is subject to change and may not be valid.

WORKER PROTECTION STANDARDS

This final rule, which was proposed in 1988 and that substantially revised standards first established in 1974, affects 3.9 million people whose jobs involve exposure to agricultural pesticides used on plants; people employed on the nation’s farms; and in forests, nurseries and greenhouses. The standard reduces pesticide risks to agricultural workers and pesticide handlers. The standard is enforceable on all pesticides with the Worker Protection Standard labeling. The provisions became fully enforceable in January 1995.

Agricultural workers in Utah now have a far greater opportunity to protect themselves, their families and others. These workers will know, often for the first time, when they are working in the presence of toxic pesticides, understand the nature of the risks these chemicals present, and get basic safety instructions.

Among the provisions of the rule are requirements that employers provide handlers and workers with ample water, soap and towels for washing and decontamination and that emergency transportation be made available in the event of a pesticide poisoning or injury. The rule also establishes restricted-entry intervals -- specific time periods when worker entry is restricted following pesticide application -- and requires personal protection equipment (PPE) for all pesticides used on farms or in forests, greenhouses and nurseries. Some pesticide products already carry restricted re-entry intervals and personal protection equipment requirements; this rule raised the level of protection and requirements for all products.

Other major provisions require that employers inform workers and handlers about pesticide hazards through safety training, which handlers have easy access to pesticide-label safety information, and that a listing of pesticide treatments is centrally located at the agricultural facility. Finally, handlers are prohibited from applying a pesticide in a way that could expose workers or other people.

GROUNDWATER CONTAMINATION BY PESTICIDES

Utah has implemented a comprehensive and coordinated approach to protect groundwater from pesticide contamination.

Formulation of the Groundwater/Pesticide State Management Plan is a cooperative effort between federal, state, and private agencies and producers/user groups; it provides a basis for continuing future efforts to protect groundwater from contamination whenever possible. Furthermore, this plan provides agencies with direction for management policies, regulations, enforcement and implementation of groundwater strategies.

While it's recognized that the responsible and wise use of pesticides can have a positive economic impact, yield a higher quality of crops, enhance outdoor activities, and give relief from annoying pests, the Utah Department of Agriculture and Food is authorized by the U.S. Environmental Protection Agency (EPA) to enforce the protection of groundwater from pesticides. Product labels will be updated as necessary.

The Utah Department of Agriculture and Food, in concert with cooperating agencies and entities, admonishes strict compliance with all pesticide labels, handling procedures and usage to protect groundwater in the state.

Groundwater can be affected by what we do to our land. Prevention of groundwater contamination is important, because once the water is polluted, it's very hard and costly to clean up. In some instances, it's impossible, especially if it's deep underground. City and urban areas especially contribute to pollution because water runoff that contains pesticides runs into drainage tunnels, then into a river or an underground stream that drains into the river. For more complete information about what groundwater is and where it comes from, read the study manual "Applying Pesticides Correctly." Shallow aquifers or water tables are more susceptible to contamination than deeper aquifers. Sandy soils allow more pollution than clay or organic soils, because clays and organic matter absorb many of the contaminants.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, establishes a policy for determining the acceptability of a pesticide use or the continuation of that use, according to a risk/benefit assessment. As long as benefits outweigh adverse effects, a pesticide can be registered by the EPA. Although the intent of a pesticide application is to apply the pesticide to the target or pest, part of the pesticide will fall on the area around the target or pest. Rain or irrigation water then can pick up the part that isn't degraded or broken down and carry it to the groundwater via leaching.

The major factors that influence the amount of contamination that can get into water are the chemicals' persistence in soil, retention time or time it remains in the soil, the soil type, the time and frequency of the application(s), soil moisture, placement of the pesticide, and the ability of the chemical to persist once in the aquatic environment. Each of these factors will influence the amount of pesticide that can leave the root zone or soil surface and percolate to groundwater.

Although some pesticides may have a high absorption quality, when they are applied to sandy soil, they will still migrate to the water table because there are no fine clay particles or organic matter to hold them. The management and use of pesticides is up to the individual applicator and/or land owner as to whether safe practices are used. Water is one of our most valuable resources; we must keep it as pure as possible.